CLAIMS

1. An electrooptic modulator comprising an optical waveguide, a cladding optically coupled to said optical waveguide, an optically functional cladding region defined in at least a portion of said cladding, and a modulation controller configured to provide a modulating control signal to said optically functional cladding region, wherein:

said optically functional cladding region defines a refractive index that is configured to vary in response to said modulating control signal applied to said optically functional region;

said refractive index of said optically functional cladding region is lower than a refractive index of said optical waveguide at an operational wavelength and an operational temperature of said device;

said optical waveguide is configured to split a propagating optical signal into first and second optical waveguide arms;

at least said second optical waveguide arm passes through said optically functional region;

said optical waveguide is configured to recombine respective propagating optical signals from said first and second optical waveguide arms after at least one of said signals passes through said optically functional region;

said modulation controller comprises a signal electrode, a ground electrode, and is configured to generate an electric field in a portion of said optically functional region associated with said second optical waveguide arm in response to a biased modulating RF control signal applied to said signal electrode and isolate a DC voltage bias generated in said signal electrode from a control signal input and a control signal termination of said signal electrode;

a magnitude and orientation of said electric field in said optically functional region of said second optical waveguide arm is sufficient to alter the refractive index of said optically functional region of said second optical waveguide arm.

2. An electrooptic modulator as claimed in claim 1 wherein:

said signal electrode and said ground electrode are configured as a traveling wave electrode structure defining a traveling wave electrode gap; and

said second optical waveguide arm passes through said optically functional region in substantial alignment with said traveling wave electrode gap.

3. An electrooptic modulator as claimed in claim 1 wherein:

said signal electrode and said ground electrode are configured as a traveling wave electrode structure defining a control signal input terminal and a control signal termination; and

said modulation controller is configured to isolate said control signal input terminal and said control signal termination from a DC bias voltage in said signal electrode.

4. An electrooptic modulator as claimed in claim 1 wherein:

said signal electrode and said ground electrode are configured as a traveling wave electrode structure defining a control signal input terminal and a control signal termination; and

said modulation controller comprises a first blocking capacitor configured to isolate said control signal input terminal from a DC bias voltage in said signal electrode and a second blocking capacitor configured to isolate said control signal termination from said DC bias voltage in said signal electrode.

5. An electrooptic modulator as claimed in claim 2 wherein:

said signal electrode and said ground electrode are configured as a traveling wave electrode structure defining a control signal input terminal and a control signal termination; and

said modulation controller comprises a blocking capacitor configured to isolate said control signal input terminal from a DC bias voltage in said signal electrode.

6. An electrooptic modulator as claimed in claim 2 wherein:

said signal electrode and said ground electrode are configured as a traveling wave electrode structure defining a control signal input terminal and a control signal termination; and

said modulation controller comprises a blocking capacitor configured to isolate said control signal termination from a DC bias voltage in said signal electrode.

7. An electrooptic modulator as claimed in claim 1 wherein said modulation controller comprises a bias voltage source configured to provide a bias voltage to said signal electrode.

8. An electrooptic modulator as claimed in claim 7 wherein said bias voltage source is configured to provide a bias voltage magnitude sufficient to enable substantial control of said refractive index of said optically functional region through modulation of said RF control signal.

9. An electrooptic modulator as claimed in claim 7 wherein said modulation controller, said optically functional region, and said second optical waveguide arm are configured such that a phase change $\Delta\phi$ in said second optical waveguide arm is proportional to:

$$AE_{DC}^2 + BE_{DC}E_{RF}$$

where A and B are constants and E_{DC} and E_{RF} correspond to the respective magnitudes of DC and RF components of said control signal.

10. An electrooptic modulator as claimed in claim 1 wherein said optically functional region is defined by a polymeric cladding medium comprising a polymer/chromophore blend or a polymer with a chromophore attached as a side chain.

11. An electrooptic modulator as claimed in claim 10 wherein said polymeric cladding medium is characterized by a predetermined degree of chromophore mobility sufficient to enable transition of said optically functional region between a substantially oriented state and a substantially isotropic state at a frequency of said control signal.

12. An electrooptic modulator as claimed in claim 10 wherein said polymeric cladding medium is characterized by a predetermined degree of chromophore mobility sufficient to enable

transition of said optically functional region between a substantially oriented state and a substantially isotropic state in less than about one second.

13. An electrooptic modulator as claimed in claim 10 wherein said polymeric cladding medium is characterized by a predetermined degree of chromophore mobility sufficient to enable transition of said optically functional region between a substantially oriented state and a substantially isotropic state in less than about 1ms.

14. An electrooptic modulator as claimed in claim 10 wherein said polymeric cladding medium is characterized by a predetermined degree of chromophore mobility sufficient to permit transition of said optically functional region between a substantially oriented state and a substantially isotropic state at a frequency in excess of 1 GHz.

15. An electrooptic modulator as claimed in claim 10 wherein said polymeric cladding medium is characterized by a predetermined degree of chromophore mobility sufficient to permit transition of said optically functional region between a substantially oriented state and a substantially isotropic state at a frequency of said RF signal.

16. An electrooptic modulator as claimed in claim 1 wherein said optically functional cladding region is characterized by an orientational mobility sufficient to enable transition between a substantially oriented state and a substantially isotropic state at a frequency of said RF control signal.

17. An electrooptic modulator as claimed in claim 1 wherein said optically functional region of said cladding comprises a Kerr Effect medium.

18. An electrooptic modulator as claimed in claim 1 wherein said optically functional region of said cladding comprises a Pockels Effect medium.

19. An electrooptic modulator as claimed in claim 1 wherein said optically functional region of said cladding defines a refractive index approximating a function that varies with a square of a magnitude of said control signal.

20. An electrooptic modulator as claimed in claim 19 wherein said function approximated by said refractive index of said optically functional cladding comprises:

$$\Delta n = \lambda K M^2$$

wherein Δn represents a change in refractive index, λ represents the wavelength of light propagating in said cladding, K represents a constant, and M represents said control signal magnitude.

21. An electrooptic modulator as claimed in claim 10 wherein said cladding medium comprises a Kerr Effect medium and K represents the Kerr constant of said Kerr Effect medium.

22. An electrooptic modulator as claimed in claim 20 wherein said control signal comprises an electric field and M represents an intensity E of said electric field.

23. An electrooptic modulator as claimed in claim 1 wherein:

said optically functional region of said cladding comprises a cladding medium configured to induce a phase shift $\Delta\phi$ in an optical signal propagating through said optically functional region in response to a control voltage V applied to said optically functional region; and

said cladding medium is configured such that successive phase shifts $\Delta\phi$ of 180° are induced in said optical signal as a magnitude of said control voltage is increased in successive increments V_π and such that said successive increments V_π decrease in magnitude as said magnitude of said control voltage is increased.

24. An electrooptic modulator as claimed in claim 23 wherein said successive increments V_π decrease according to a quadratic relationship with said control voltage.

25. An electrooptic modulator as claimed in claim 1 wherein said optically functional region of said cladding comprises an un-poled, substantially isotropic polymeric cladding medium.

26. An electrooptic modulator as claimed in claim 1 wherein said optically functional region of said cladding comprises a poled, substantially anisotropic polymeric cladding medium.

27. An electrooptic modulator as claimed in claim 1 wherein said waveguide device further comprises a controller configured to control an operating temperature of said optically functional cladding region.

28. An electrooptic modulator as claimed in claim 27 wherein said controller is programmed to maintain said operating temperature at a value sufficient to yield an optically functional region refractive index n_p of at least about 0.3% lower than a refractive index n_w of said optical waveguide.

29. An electrooptic modulator as claimed in claim 27 wherein said controller is programmed to maintain said operating temperature at a value sufficient to yield an optically functional region refractive index n_p between about 0.3% and about 1.0% lower than a refractive index n_w of said optical waveguide.

30. An electrooptic modulator as claimed in claim 1 wherein said optically functional cladding region comprises a negative dn/dt polymer defining a refractive index n_p that decreases as temperature increases.

31. An electrooptic modulator as claimed in claim 30 wherein said optical waveguide comprises a positive dn/dt polymer defining a refractive index n_p that increases as temperature increases.

32. An electrooptic modulator as claimed in claim 30 wherein said optically functional region refractive index n_p decreases under increasing temperature at a rate sufficient to yield an

refractive index n_p between about 0.3% and about 1.0% lower than a refractive index n_w of said optical waveguide.

33. An electrooptic modulator as claimed in claim 32 wherein said refractive index n_p is at least about 0.3% lower than said refractive index η_w at a temperature of between about 60°C and about 90°C.

34. An electrooptic modulator as claimed in claim 32 wherein said refractive index n_p is between about 0.3% and about 1.0% lower than said refractive index n_w at a temperature of between about 60°C and about 90°C.

35. An electrooptic modulator as claimed in claim 1 wherein:

said optically functional cladding region and said waveguide are positioned between upper and lower support layers;

said signal electrode and said ground electrode are positioned in a common plane substantially parallel to one of said support layers;

said signal electrode and said ground electrode are separated by a widthwise gap g in said common plane;

said waveguide extends along a plane parallel to said common plane and said parallel plane is offset from said common plane by a distance h;

said signal electrode defines a widthwise dimension w in said common plane; and

said ground electrode defines a widthwise dimension s in said common plane.

36. An electrooptic modulator as claimed in claim 1 wherein said waveguide, said signal electrode, and said ground electrode are configured to achieve about 50 ohms of impedance across said signal electrode and said ground electrode.

37. An electrooptic modulator as claimed in claim 1 wherein said waveguide, said signal electrode, and said ground electrode are configured such that:

said widthwise gap g is between about 2μm and about 50μm;

said distance h is between about 0 and about 50μm;

said widthwise dimension w is between about 5μm and about 500μm; and

said widthwise dimension s is between about 5μm and about 2000μm.

38. An electrooptic modulator as claimed in claim 1 wherein said waveguide, said signal electrode, and said ground electrode are configured such that:

said widthwise gap g is between about 10μm and about 50μm;

said distance h is about zero;

said widthwise dimension w is between about 5μm and about 500μm; and

said widthwise dimension s is between about 5μm and about 2000μm.

39. An electrooptic modulator as claimed in claim 1 wherein said waveguide, said signal electrode, and said ground electrode are configured such that:

said widthwise gap g is between about 10μm and about 20μm;

said distance h is between about 5μm and about 11μm;

said widthwise dimension w is between about 10μm and about 200μm; and

said widthwise dimension s is between about 10μm and about 500μm.

40. An electrooptic modulator as claimed in claim 1 wherein said waveguide, said signal electrode, and said ground electrode are configured such that:

said widthwise gap g is between about 15μm and about 40μm;

said distance h is about zero;

said widthwise dimension w is between about 10μm and about 200μm; and

said widthwise dimension s is between about 10 and about 300μm.

41. An electrooptic modulator as claimed in claim 1 wherein:

said optically functional cladding region and said waveguide are positioned between upper and lower support layers; and

said signal electrode is positioned against one of said upper and lower support layers and said ground electrode is positioned against the other of said upper and lower support layers.

42. An electrooptic modulator as claimed in claim 36 wherein said waveguide is spaced from said upper and lower support layers by a spacer layer.

43. An electrooptic modulator as claimed in claim 1 wherein:

a modulated output of said electrooptic modulator is integrated with an input of a wavelength selective device;

said wavelength selective device defines a plurality of inputs, each coupled to additional modulated outputs of additional electrooptic modulators; and

said wavelength selective device is configured to generate a multiplexed signal from said plurality of modulated outputs.

44. An electrooptic modulator as claimed in claim 43 wherein said wavelength selective device and said plurality of modulators are configured on a common substrate.

45. An electrooptic modulator as claimed in claim 43 wherein said wavelength selective device comprises an arrayed waveguide grating.

46. An electrooptic modulator as claimed in claim 1 wherein:

an input of said electrooptic modulator is integrated with an demultiplexed output of a wavelength selective device;

said wavelength selective device defines a plurality of demultiplexed outputs, each coupled to additional inputs of additional electrooptic modulators; and

said wavelength selective device is configured to generate said demultiplexed outputs from a multiplexed signal.

47. An electrooptic modulator as claimed in claim 46 wherein said wavelength selective device and said plurality of modulators are configured on a common substrate.

48. An electrooptic modulator as claimed in claim 1 wherein:

an input of said electrooptic modulator is integrated with a λ_1 add channel of an optical network;

a modulated output of said electrooptic modulator is integrated with a λ_1 optical transmission line via an electrooptic switch and a λ_1 add line of an "add" wavelength selective device;

said λ_1 optical transmission line is integrated with a λ_1 drop channel of said optical network via a λ_1 drop line of a "drop" wavelength selective device and said electrooptic switch.

49. An electrooptic modulator as claimed in claim 48 wherein:

additional inputs of additional electrooptic modulators are integrated with additional λ_i add channels of an optical network;

additional modulated outputs of said electrooptic modulators are integrated with a respective λ_n optical transmission lines via additional electrooptic switches and additional λ_n add lines of said "add" wavelength selective devices;

said additional λ_n optical transmission lines are integrated with additional λ_n drop channels of said optical network via additional λ_n drop lines of said "drop" wavelength selective device and said additional electrooptic switches.

50. An electrooptic modulator as claimed in claim 49 wherein said electrooptic modulators, said "add" wavelength selective device, said "drop" wavelength selective device, said transmission line, and said electrooptic switches are configured on a common substrate.

51. An optical device comprising:

an optical transmission line configured to carry a plurality of optical signals λ_1, $\lambda_{2,}$ λ_n;

a plurality of add channels coupled to said optical transmission line via an array of electrooptic modulators, an array of electrooptic switches, and an "add" wavelength selective device;

a plurality of drop channels coupled to said optical transmission line via said array of electrooptic switches, and a "drop" wavelength selective device, wherein

said array of electrooptic switches are configured to drop from said optical transmission line a signal of a selected wavelength λ_i while adding to said optical transmission line a corresponding signal of said selected wavelength λ_i from one of said electrooptic modulators,

each of said electrooptic modulators comprises an optical waveguide, a cladding optically coupled to said optical waveguide, an optically functional cladding region defined in at least a portion of said cladding, and a modulation controller configured to provide a modulating control signal to said optically functional cladding region,

said optically functional cladding region defines a refractive index that is configured to vary in response to said modulating control signal applied to said optically functional region,

said refractive index of said optically functional cladding region is lower than a refractive index of said optical waveguide at an operational wavelength and an operational temperature of said device.

52. An optical device as claimed in claim 51 wherein said optical transmission line, said plurality of add channels, said array of electrooptic modulators, array of electrooptic switches, said "add" wavelength selective device, said "drop" wavelength selective device, are configured on a common substrate.

53. An optical device as claimed in claim 51 wherein said wavelength selective device comprises an arrayed waveguide grating.

54. An optical device as claimed in claim 51 wherein:

said optical waveguide is configured to split a propagating optical signal into first and second optical waveguide arms; and

at least said second optical waveguide arm passes through said optically functional region.

55. An optical device as claimed in claim 54 wherein said modulation controller comprises a signal electrode and a ground electrode configured to generate an electric field in a portion of said optically functional region associated with said second optical waveguide arm in response to a control signal applied to said signal electrode.

56. An optical device as claimed in claim 54 wherein said control signal comprises a modulating RF signal.

57. An optical device as claimed in claim 56 wherein a magnitude and orientation of said electric field in said optically functional region of said second optical waveguide arm is sufficient to alter the refractive index of said optically functional region of said second optical waveguide arm.

58. An electrooptic modulator array comprising:

an array of optical waveguides configured to split a propagating optical signal into respective pairs of optical waveguide arms and recombine said optical signals;

an optically functional cladding region defined in at least a portion of a cladding optically coupled to said array of optical waveguides, wherein said optically functional cladding region is configured such that at least one of said optical waveguide arms of each pair of optical waveguide arms passes through said optically functional cladding region;

a modulation controller configured to provide a modulating control signal to said optically functional cladding region, wherein said modulation controller comprises an array of signal electrodes and at least one ground electrode dedicated to individual ones of said optical waveguide arms passing through said optically functional region, wherein

said signal and said ground electrodes are configured to generate respective electric fields in said optically functional cladding region in response to respective control signals applied to different ones of said signal electrodes,

said optically functional cladding region defines a refractive index that is configured to vary in response to said electric fields, and

said signal and ground electrodes, said optically functional cladding region, and said array of optical waveguides are configured such that said respective electric fields generated in said optically functional cladding regions alter respective refractive indices associated with individual ones of said optical waveguide arms passing through said optically functional region.

59. An electrooptic modulator array as claimed in claim 58 wherein said array of optical waveguides, said optically functional cladding region, and said signal and said ground electrodes are configured on a common substrate.

60. An electrooptic modulator array as claimed in claim 59 wherein said electrooptic modulator array further comprises a wavelength selective device defined on said common substrate.

61. An electrooptic modulator array as claimed in claim 58 wherein said electrooptic modulator array further comprises a wavelength selective device configured to multiplex respective signals propagating along said array of optical waveguides.

62. An electrooptic modulator array as claimed in claim 58 wherein said electrooptic modulator array further comprises a wavelength selective device configured to demultiplex an input signal and direct respective demultiplexed signals to propagate along individual ones of said array of optical waveguides.

63. An electrooptic modulator array as claimed in claim 58 wherein said electrooptic modulator array further comprises an arrayed waveguide grating and said array of optical waveguides, said optically functional cladding region, said signal and said ground electrodes and said arrayed

waveguide grating are configured on a common substrate.